Catechol-mediated Functional Coatings of Polymer and Inorganic Nanostructures

김지선[a], 박재윤[a], 손호연[a], 이해신[b,c,d], 남윤성[a,c,d,*]
한국과학기술원 [a]신소재공학과, [b]화학과, [c]나노융합연구소, [d]바이오융합연구소 (Email: yoonsung@kaist.ac.kr)

초 록: As polymer coatings of nano-structured surface become significant to obtain functionalized materials, catechol derived from a mussel protein has attracted increasing attention for its universal adhesiveness. In addition to the unique adhesion property, its reducing ability of metal ions during oxidative polymerization to polydopamine (pD) widely expands the application of catechol molecules in the field of surface modification. In this study, we present the catechol conjugated smart polymer coatings for regulating surface properties such as wettability and anti-fouling effects. In additino, the *in situ* silver coating of electrospun polymer nanofibers using a silver-catechol redox reaction is presented as a simple method to produce metal nanostructures.

1. 서론

Catechol is very attractive in the field of surface modification because it can strongly bind to the surface in aqueous environment. Due to its universal adhesiveness, catechol-mediated coatings can be readily accomplished in aqueous milieu. Catechol-terminated poly(*N*-isopropylacrylamide) was adopted to obtain the thermally responsive nanopore system, and dextran grafted with catechols was investigated as a functional material for preventing non-specific protein adsorption on the prosthetic materials. In addition, electrospun poly(vinyl alcohol) nanofibers were coated with silver nanoparticles in methanol through an one-pot process of catechol polymerization and reduction of silver ions on the nanofibers.

2. 본론

We suggest a one-step method to modify the pore surface of an anodized aluminum oxide (AAO) membrane using universal adhesion property of catechol conjugated polymer. PNIPAAm (12 kDa) is synthesized via RAFT polymerization, followed by the conjugation of catechol to one chain end. The catechol-conjugated PNIPAAm is successfully grafted to the surface of nanopores by aqueous polymer solution infiltration through a membrane. The thermally controlled wettability of the grafted PNIPAAm chain is correlated to the contact angle and diffussivity of the membrane.

We also investigated anti-foluing ability of catechol conjugated dextran polymer. Surface modification of prosthetic materials to prevent protein adsorption is the main issues in implantation. There have been various attempts to give antifouling ability to the material for medical implantation; however, insufficient stability and degradation due to the aqueous environment made it difficult to maintain the desired effects. Here, we propose catechol-grafted dextran as a promising coating material for metallic implant materials. Titanium dioxide is coated with catechol-grafted dextran via strong adhesive capability of catechol. The surface-modified titanium dioxide is subsequently tested to examine the anti-fouling effect against serum albumin and showed excellent resistance to non-specific protein adsorption.

Lastly, we employ pD coatings with simultaneous reduction of metal ions to prepare electrospun polymer nanofibers functionalized with metal nanoparticles. The oxidative polymerization of dopamines mediates the reduction of silver ions to metallic silver nanoparticles and their deposition on polymer nanofibers. PVA is electrospun to nanofibers and then incubated in a mixture of

dopamine hydrochloride and silver nitrate ($AgNO_3$) in methanolic solution. The formation of silver-pD-coated PVA nanofibers stabilizes the porous structure of nanofibers in aqueous solution even with vigorous stirring. Although pD coating usually generates irregular aggregates on the nanofibers, one-pot synthesis of a silver-pD hybrid layer on electrospun nanofibers shows a relatively uniform surface morphology.

3. 결론

A catechol conjugated or assisted coating method is advantageous for the simple process in aqueous phase. The various applications based on the highly stable adhesiveness of catechol to organic or inorganic surfaces in water were demonstrated in our functional surface system. We expect that our facile approach to modify the surface using catechol can promote the fabrication of nano-structures to provide smart functionality.

참고문헌

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